

REMARKS

Applicants have amended pages 9 and 13 of their specification, to clarify that the comb teeth structure is formed on each of two sides of the diffusion layer “opposite” each other. This clarifies positioning of the two comb teeth structures for a fuel gas diffusion layer or oxidizing agent diffusion layer, as would have been recognized by one of ordinary skill in the art. In this regard, note, for example, the first full paragraph on page 5 of the Office Action mailed February 20, 2007. It is respectfully submitted that this amendment to the specification does not add new matter to the application.

Applicants have amended the paragraph bridging pages 10 and 11 of their specification, to describe diffusion layers “12” and separator “10”, consistent with Fig. 2(b) of Applicants’ original disclosure. Note also page 11, line 1, and the paragraph bridging pages 11 and 12, of Applicants’ specification. It is respectfully submitted that this amendment in the paragraph bridging pages 10 and 11 of Applicants’ specification does not constitute new matter.

Applicants have amended their Abstract in order to delete sufficient words such that the Abstract is less than 150 words, while still disclosing the subject matter of the present invention. In view of the submitted Substitute Abstract, it is respectfully submitted that the objection to the Abstract as set forth in Item 5 on page 4 of the Office Action mailed February 20, 2007, is moot.

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have amended claims 1 and 8 to differentiate between fuel gas and oxidizing gas structures (e.g., a “fuel gas” manifold and an “oxidizing gas” manifold, a “fuel gas” diffusion layer and an “oxidizing gas” diffusion layer, etc.); to recite another “comb teeth” structure

between the oxidizing gas passage section and the oxidizing gas manifold; to recite that the comb teeth structure and the another comb teeth structure have comb teeth; and to recite that the fuel gas diffusion layer and the oxidizing gas diffusion layer are of a porous material, and at least one of (a) the comb teeth structure is part of the fuel gas diffusion layer and (b) the another comb teeth structure is part of the oxidizing gas diffusion layer. Note, e.g., pages 6 and 10-12 of Applicants' specification.

Similarly, Applicants have amended claim 12 to recite a gas diffusion layer which is placed so as to come into contact with the seal sheet; and have further amended claim 12 to recite that the separator structure includes a comb teeth structure, having comb teeth, provided on the gas diffusion layer, with the gas manifold and the diffusion layer being in communication with each other via slit spaces between the comb teeth in the comb teeth structure, and wherein the diffusion layer is of a porous material and the comb teeth structure is part of the diffusion layer.

Applicants have amended the remaining previously considered claims, which are dependent claims, in light of amendments to independent claims 1, 8 and 12, and, moreover, have further amended the dependent claims are discussed in the following. That is, claim 2 has been amended to recite first and second "separators"; and claim 3 has been amended to recite that the comb teeth structure and the another comb teeth structure are positioned on "an" extension of convexes in the fuel gas and oxidizing gas passage sections respectively of the first and second separators. Claims 4-6 have been amended to recite "at least one of" the fuel gas diffusion layer and the oxidizing gas diffusion layer. Claim 7 has been amended to recite that the comb teeth structure is formed on each of two sides of the "fuel gas"

diffusion layer "opposite to" each other. Claims 9-11 have been amended to recite first and second separators and first and second seal sheets, and to recite the comb teeth structure and another comb teeth structure.

It is emphasized that the previously considered claims have been amended to clarify structure relating to the oxidizing gas and structure relating to the reducing gas.

Moreover, Applicants are adding new claims 17-22 to the application. Claim 17, dependent on claim 1, recites that the comb teeth structure is a part of the fuel gas diffusion layer and the another comb teeth structure is a part of the oxidizing gas diffusion layer. Claims 18-20, dependent respectively on claims 4-6, respectively recites that the slit spaces between the comb teeth of each of the comb teeth structure and the another teeth structure are arranged at the recited pitch; recites that a thickness of each of the fuel gas diffusion layer and the oxidizing gas diffusion layer is set at the recited thickness; and recites that the void fraction of each of the fuel gas diffusion layer and the oxidizing gas diffusion layer is set at the specified percentage when no load is applied. Claim 21, dependent on claim 1, recites that the another comb teeth structure is formed on each of two sides of the oxidizing gas diffusion layer opposite each other; and claim 22 recites subject matter expressly set forth in claim 18, but is dependent on claim 11.

Applicants respectfully traverse the objection to the drawings, set forth in Items 3 and 4 on pages 2-4 of the Office Action mailed February 20, 2007, in view of the following.

Thus, in Item 3, the Examiner objects to the drawings because a description recited on page 11, lines 5-8, is not shown in the drawings, the Examiner contending that there is no diffusion layer 2 or separator 1 in any of Figs. 2A-2D, and these

reference characters do not correlate with the initial reference character description provided in the paragraph bridging pages 5 and 6. Note that the paragraph bridging pages 10 and 11 of Applicants' specification has been amended to describe separator "10" and diffusion layers "12". Note Figs. 2A, 2B, 2C, 2D and 2E, of Applicants' original disclosure. Accordingly, it is respectfully submitted that there is now correspondence between the structure in the paragraph bridging pages 10 and 11 of Applicants' specification, and in Figs. 2A-2E, so that amendments to the drawings in connection therewith are not necessary.

Applicants respectfully traverse the conclusion by the Examiner that the drawings fail to show the comb teeth on or in the diffusion layer as described on page 11, lines 5-8. In connection therewith, the Examiner's attention is respectfully directed to Fig. 2B, showing diffusion layers 12 with comb teeth structure 33 having a plurality of teeth formed on one side of the diffusion layers 12. In view thereof, since the drawing figures show the comb teeth on the diffusion layer, it is respectfully submitted that corrected drawing sheets are not necessary.

The objection to the drawings as set forth in Item 4 on page 3 of the Office Action mailed February 20, 2007, is noted. This objection is based upon the contention by the Examiner that the drawings do not show the diffusion layer having the comb teeth structure. However, as shown previously, it is respectfully submitted that Fig. 2B clearly shows the diffusion layers 12 having the comb teeth structure 33. It is respectfully submitted that the drawings show "every feature of the invention specified in the claims", and thus additional drawings showing such feature are not necessary.

The contention by the Examiner that the diffusion layers 12 are not shown to have the comb teeth structure itself but instead are adjacent to the comb teeth

structure provided in the separator 10, the Examiner referring to Fig. 2E, is noted. Again, attention is respectfully directed to Fig. 2B, showing the comb teeth structure 33 on the diffusion layer 12.

The objection to claim 1 as set forth in Item 6 on page 4 of the Office Action mailed February 20, 2007, is noted. It is respectfully submitted that this objection is moot in light of present amendments to claim 1.

Applicants respectfully traverse the rejection of all of their claims under the first paragraph of 35 USC 112, as failing to comply with the enablement requirement, set forth in Item 7 on pages 4 and 5 of the Office Action mailed February 20, 2007. This rejection is apparently based on the reading by the Examiner that the two surfaces of the diffusion layer on opposite sides thereof in the thickness direction do not "face" each other, but rather are "on opposite sides" of the diffusion layer. Applicants have amended their specification and claim 7, to recite that the comb teeth structure is formed on each of two sides of the diffusion layer "opposite to" each other. Based upon the Examiner's interpretation of the structure where there is a single layer, it is respectfully submitted that one of ordinary skill would have known, as of the filing date of the above-identified application that the comb teeth structures were on sides of the diffusion layer "opposite to" each other. In view of this amendment to the specification, it is respectfully submitted that the rejection under the first paragraph of 35 USC 112, is moot.

Applicants respectfully traverse the rejection of their claims under the second paragraph of 35 USC 112, as being indefinite, especially insofar as this rejection is applicable to the claims as presently amended. Thus, Applicants have amended their claims in connection with antecedent basis, and have amended their claims to refer to "a" structure, including "a fuel gas manifold" and "an oxidizing gas manifold",

upon first recitation of these structures. In view of amendments to claim 1, as well as amendments to the remaining claims, it is respectfully submitted that bases for rejection of the claims under the second paragraph of 35 USC 112, set forth in Items 8.a-c on pages 5-7 of the Office Action mailed February 20, 2007, are moot. Similarly, in view of amendments to the present claims, it is respectfully submitted that bases for rejection of the claims under the second paragraph of 35 USC 112, set forth in Items 8.d-f on page 7 of the Office Action mailed February 20, 2007, are moot. In this regard, Applicants have amended their claims to clarify structure with respect to the "fuel gas" side of the cell and with respect to the "oxidizing gas" side of the cell; and particularly in view thereof, it is respectfully submitted that the claims are clear with respect to the various slit spaces, comb teeth structure, diffusion layers, etc., being referred to.

Applicants have amended claim 7 to recite that the comb teeth structure is formed on each of two sides of the fuel gas diffusion layer "opposite to" each other; it is respectfully submitted that there is sufficient antecedent basis for sides of the diffusion layer "opposite to" each other in the present claims.

The contention by the Examiner that there is no antecedent basis for "the diffusion layer facing each other" is noted. It is respectfully submitted that the claims recite two sides of the diffusion layer "opposite to" each other; and it is respectfully submitted that there is sufficient antecedent basis for this structure as presently recited in claim 7.

Claim 9 has been amended to recite first and second "separators", on which the "first and second" seal sheets respectively are placed; in view thereof, it is respectfully submitted that there is sufficient antecedent basis for recitations in

claim 9. Similarly, in light of amendments to claim 14, it is respectfully submitted that there is no need for antecedent basis, claim 14 reciting “an” extension.

The word “preferable” has been deleted from claim 13; accordingly, basis for rejection of claim 13 as set forth in Item 8j on page 8 of the Office Action mailed February 20, 2007, is moot.

Applicants respectfully traverse the conclusion by the Examiner that the term “pitch” is indefinite. Note that, for example, claims 4, 11 and 15 recite that the slit spaces between the comb teeth “are arranged at” the recited pitch. It is respectfully submitted that this provides a sufficiently definite recitation as to pitch so as to define what this refers to. It is respectfully submitted that “pitch” has a definite dictionary definition.

As can be seen in the foregoing, as well as from the extensive amendments to the claims, Applicants have made a bona fide attempt to overcome all issues under 35 USC 112, first and second paragraphs, by amendments to the specification and claims. If the Examiner is of the opinion that any issues remain, the Examiner is respectfully requested to contact the undersigned, so as to discuss appropriate language for overcoming any such remaining issues. The Examiner is respectfully thanked in advance for complying with this request.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the prior art applied by the Examiner in rejecting claims in the Office Action mailed February 20, 2007, i.e., the teachings of the U.S. patent publications to Wakamatsu, Patent No. 6,231,053, and to Hatoh, et al., Patent Application Publication No. 2004/0110056, and Japanese Patent Document No. 2001-266910, under the provisions of 35 USC 102 and 35 USC 103.

It is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such a fuel cell as in the present claims, having the recited fuel gas diffusion layer and oxidizing gas diffusion layer, with a comb teeth structure, having comb teeth, provided between the fuel gas passage section and fuel gas manifold of the fuel cell and another comb teeth structure, having comb teeth, being provided between the oxidizing gas passage section and the oxidizing gas manifold, slit spaces being formed between the comb teeth so as to be in communication with the fuel gas and oxidizing gas diffusion layers, and the fuel gas manifold in the first separator being in communication with the fuel gas passage section via the split spaces between comb teeth of the comb teeth structure and the oxidizing gas manifold in the second separator being in communication with the oxidizing gas passage section via the slit spaces between comb teeth of the another comb teeth structure, the fuel gas and oxidizing gas diffusion layers being of a porous material, and at least one of (a) the comb teeth structure is part of the fuel gas diffusion layer and (b) the another comb teeth structure is part of the oxidizing gas diffusion layer (see claims 1 and 8); in particular, wherein the comb teeth structure and the another comb teeth structure are both part of the respective diffusion layers (see claim 17).

In addition, it is respectfully submitted that the applied references would have neither taught nor would have suggested such separator structure as in the present claims, including the gas diffusion layer placed so as to come into contact with the seal sheet sealing the separator periphery, and a comb teeth structure, having comb teeth, provided on the gas diffusion layer, the gas manifold and diffusion layer being in communication with each other via slit spaces between the comb teeth in the

comb teeth structure, and wherein the diffusion layer is of a porous material and the comb teeth structure is part of the diffusion layer. See claim 12.

Moreover, it is respectfully submitted that the applied references would have neither disclosed nor would have suggested such fuel cell or separator structure as in the present claims, having features as discussed previously in connection with claims 1, 8 and 12, and, additionally, having further features as in the dependent claims, including (but not limited to) thickness of the periphery around each of the first and second separators, as in claims 2 and 9 (note also claim 13); and/or positioning of the comb teeth structure as in claims 3, 10 and 14; and/or pitch of the slit spaces as in claims 4, 11 and 15; and/or void fraction of the diffusion layer(s), as in claims 6 and 16; and/or wherein the comb teeth structure is formed on each of two sides of the fuel gas or oxidizing gas diffusion layer, opposite to each other (see claims 7 and 21).

The present invention is directed to a fuel cell and separator structure used therein. A problem with prior fuel cells is that such fuel cells tend to suffer pressure drop caused by a sudden change in passage cross-section at the connection of a manifold thereof, provided around the separator, to supply a gas or to discharge a gas from each cell. Increased pressure drop in the fuel cell requires increased capacity of the blower which supplies air to the cell, increasing losses at auxiliary devices or increasing discharge pressure of a hydrogen generating unit which supplies a fuel gas to the cell, making the overall system more complex. Note the paragraph bridging pages 1 and 2 of Applicants' specification.

Against this background, Applicants provide structure wherein such pressure drop is reduced, without increasing overall thickness of the separator. Applicants have found that through use of the gas diffusion layer as in the present claims,

having the recited comb teeth structure, increase in pressure drop can be avoided, without unduly increasing cell thickness. Thus, by forming the diffusion layer of a porous material, and with the comb teeth structure which substantially expands gas passage cross-section at connections of the manifold to the electrode section, reduced pressure drop is achieved. Note the first full paragraph on page 6 of Applicants' specification.

In addition, by providing the comb teeth structure on an extension of the convexes in the gas passage section of the separator, smoother connection of the gasses is flowing in the gas passages in the comb teeth structure, into the passages in the separator, is allowed, thereby controlling pressure drop increase. Note the last full paragraph on page 6 of Applicants' specification.

Furthermore, by providing the comb teeth arranged at a pitch as in the present claims, cross-section of the gas passages is expanded, without decreasing sealing capacity. Note the first full paragraph on page 7 of Applicants' specification.

In addition, with thickness of the diffusion layer as in the present claims, corresponding to height of the comb teeth structure, pressure drop is reduced, without increasing resistance to flow of gasses towards the electrode catalyst. Note the last full paragraph on page 7 of Applicants' specification.

As for other advantages of the present invention as in the present claims, note discussions on pages 7-10 of Applicants' specification.

Japanese Patent Document No. 2001-266910 discloses a solid polymer electrolyte fuel cell stack, having a separator 1 (note Fig. 1) and base member 2, and with an introduction oval region 20 made of metallic material having constant strength, with introduction passage 121 being formed integrally in an introduction line 12 in order to introduce fuel gas, oxidation gas from inside manifold 11 to each cell.

See the English Abstract of No. 2001-266910; note also paragraphs [0009], [0010], [0017] and [0025] of the computer translation of No. 2001-266910.

It is respectfully submitted that No. 2001-266910 would have neither taught nor would have suggested such diffusion layer, made of a porous material and having the comb teeth structure, as in the present claims, and advantages thereof as discussed in the foregoing.

The interpretation by the Examiner of the teachings of No. 2001-266910, as set forth in the paragraph bridging pages 9 and 10 of the Office Action mailed February 20, 2007, is noted. Contrary to this interpretation by the Examiner, it is respectfully submitted that the applied Japanese patent document does not disclose, nor would have suggested, such diffusion layer or layers as in the present claims, especially having the recited comb teeth structure, or the other features of the present invention as discussed previously.

It is respectfully submitted that the additional teachings of Wakamatsu and/or of Hatoh, et al. would have not have rectified deficiencies of the applied Japanese patent document, such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Wakamatsu discloses gaskets as sealing devices for fuel cells, such as stacked fuel cells. The gaskets include a gasket body including a metal frame and a resin sheet and having openings, and a sealing section including a liquid rubber vulcanizate, the sealing section being bonded to the gasket body, and the interface of each of the openings being covered with a sealing section. This patent document discloses that in various aspects, the gasket body preferably has a thickness in a range of 0.03-0.3 mm. See column 2, lines 10-16, 56 and 57. Note also column 2, lines 36-44; and column 3, lines 38-44 and 57-61.

Hatoh, et al. discloses a fuel cell comprising a stack of unit cells, each unit cell including an anode and a cathode with a hydrogen-ion conductive electrolyte interposed therebetween; an anode-side conductive separator in contact with the anode and a cathode-side conductive separator in contact with the cathode, the anode-side conductive separator including fuel gas passage grooves facing the anode and the cathode-side conductive separator comprising oxygen gas passage grooves facing the cathode. This patent document discloses that at least one of the fuel gas passage grooves and the oxidant gas passage grooves has an equivalent diameter of not smaller than 0.79 mm and not larger than 1.3 mm per each groove. Note paragraph [0020] on page 2 of this patent publication. Note also paragraph [0024] on page 3 thereof, disclosing that it is preferable that each of the anode and cathode comprises a gas diffusion layer and a catalyst reaction layer in contact with the gas diffusion layer, with at least one of the gas diffusion layers of the anode and cathode having a thickness of about 100-400 μm .

Even assuming, arguendo, that the teachings of Wakamatsu or Hatoh, et al. were properly combinable with the teachings of the applied Japanese patent document, such combined teachings would have neither disclosed nor would have suggested such fuel cell or separator structure as in the present claims, including the gas diffusion layer or layers with the comb teeth structure, and advantages thereof; and/or other features of the present invention as in the dependent claims, and further advantages thereof.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently in the application are respectfully requested.

To the extent necessary, Applicants hereby petition for an extension of time under 37 CFR 1.136. Kindly charge any shortage of fees due in connection with the

filing of this paper, including any extension of time fees, to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Account No. 01-2135 (case 500.43536X00), and please credit any overpayments to such Deposit Account.

Respectfully submitted,

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Enclosure: Substitute Abstract of the Disclosure (p. 22)

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